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(54) A method of stabilizing a ballast railway track

Verfahren zum Stabilisieren eines Schottergleises

Procédé pour la stabilisation du ballast d'une voie ferrée

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Description

Technical Field

[0001] The present invention relates to a high strength prepacked concrete track construction process thereof, and more particularly to a high strength prepacked concrete track construction process in which existing sleepers and fasteners are replaced, an existing ballast layer is excavated and geosynthetics are installed on a roadbed layer, and existing ballast gravels, that are dry-washed on the spot, are filled therein and high strength and super early strength cement mortar is injected thereto to form a high strength and super early strength prepacked cement ballast layer to thereby replace the existing gravel ballast track with a concrete ballast track.

Background Art

[0002] Tracks are a portion that supports weight of a train in the railway, transmits the weight to a roadbed, and guides running of the train. Particularly, the running stability and driving comport of the train are directly influenced by the performance of the track, and interaction between the track and the train is the greatest factor on noises and vibrations.

[0003] The gravel ballast track is a conventional basic track structure, which is of cheap construction costs and proper track elasticity so that upon occurrence of track deviation, it is relatively easily rearranged. In the ballast track, the gravels are positioned at the lowest portion of the track, serving to absorb shocks upon train running to mitigate the vibrations, and distribute the load of the train transmitted via the sleepers to thereby prevent a rail from subsiding or moving. Further, it facilitates the draining of rainwater and prevents grasses from growing on the ballast.

[0004] However, since the gravels are likely to be broken into pieces due to frequent friction, and draining is likely to become worse and the gravels to lose their elasticity due to an influx of earth and sand, it needs periodic ballast cleaning or replacing, taking much labor, cost and time.

[0005] Recently, as track deviation of the gravel ballast track increases in speed due to making the speed, weight and density of the train speedy, heavy and dense, maintenance cost of the track also increases, so that concrete ballast or slab ballast track is constructed.

[0006] The concrete ballast has an advantage in that the maintenance work is mitigated, the draining is good, and vibrations of the ballast and the train are reduced. The slab ballast is of a structure in which the sleepers and the ballast are made in one piece, so that the track deviation and ballast sinking due to speed-up of the train are reduced to save the maintenance cost. Thus, upon newly constructing, the existing gravel ballast track is gradually replaced with a concrete or slab track, and an efficient track has been studied which is capable of re-

ducing the maintenance that is the problem in the existing gravel ballast track. However, since a market share of the conventional gravel ballast track is still large at present, it is effective that the existing ballast gravel track is modified to provide a concrete ballast track such as a slab track or the like.

[0007] A conventional ballast modifying construction is generally carried out so as to improve the antiquated gravel ballast track used in subway, through the processes of removal of existing tracks, installing of new sleepers, a concrete form, a jacket and a temporary support, and pouring and curing of concrete in sequence, the processes and structure of which are similar to those of the construction of the slab track and that of the track. KR 2006 0021688 A describes a construction method of a railway track including a roadbed layer, a geotextile having a lower part and sides mounted thereon, and a ballast layer hardened by pouring cement mortar. However, different from the subway track, the gravel ballast track of the existing railway has no invert so that problems are caused in that upon pouring of concrete, the concrete flows out, the construction speed is slow because the construction is dependent on manpower, and the train speed is restricted in a state where the temporary support is installed so that the operation of the train is delayed for a long time.

[0008] Thus, it needs to develop a technique-intensive track structure capable of completing a certain working within a restricted construction period without affecting the operation of the train, and normally operating the train just after the construction.

Disclosure of Invention

Technical Problem

[0009] The present invention has been made to solve the above problems occurring in the prior art, and an object of the present invention is to provide a new concrete track construction process capable of preventing outflow of concrete with the provision of geosynthetics even without installation of an invert.

[0010] Another object of the present invention is to provide a new concrete track construction process capable of carrying out the evacuation of existing ballast, installation of geosynthetics, and filling of new ballast layer with machine such as using a ballast cleaner and a gravel dry-washer.

[0011] Further object of the present invention is to provide a new concrete track construction process in which high strength and super early strength cement mortar is injected into a new ballast layer using a cement mortar injector without installing the temporary support during the ballast modification, to thereby form a high strength and super early strength prepacked concrete ballast layer.

Technical Solution

[0012] In order to accomplish the above and other objects, there is provided a prepacked concrete track structure is provided which comprises geosynthetics installed on a roadbed layer, a new ballast layer formed on the geosynthetics, a sleeper installed on the new ballast layer, a fastener installed on the sleeper, and a rail connected to the fastener, wherein the geosynthetics is installed such that the bottom thereof is brought into contact with the upper portion of the roadbed layer, right and left sides of the bottom of the geosynthetics having side faces perpendicular to the bottom; wherein the new ballast layer is composed of high strength and super early strength prepacked concrete that is filled and cured in the internal space where the geosynthetics are installed; wherein the sleeper consists of the plurality of sleepers installed on the new ballast layer parallel with each other; and wherein the rail is connected on the upper surface of the sleeper using the fastener so as to be perpendicular to the sleeper.

Advantageous Effects

[0013] According to the concrete ballast track structure and the construction process thereof, the geosynthetics are previously installed, new ballast gravels are filled therein, and the cement mortar is injected thereto, to thereby prevent flow-out of the prepacked concrete without installing a separate invert.

[0014] Further, the existing ballast gravels are re-used without removal, and the removal process of the ballast, that is dependent on labor, is carried out using the ballast cleaner so that the construction speed is greatly increased.

[0015] Further, while during the existing ballast improving process, the temporary support is installed so that the speed of the running train should be restricted, according to the present invention, a new ballast layer is formed with high strength and super early strength prepacked concrete, which does not affect the operation of the train.

[0016] Particularly, since all the processes of the ballast improvement construction are carried out using machine, the construction period is greatly shortened so that the construction process is suitable to maintenance or construction of the railway track within a restricted period.

Brief Description of the Drawings

[0017]

FIGS. 1 to 3 are a schematic perspective view, a sectional view, and side sectional view illustrating a concrete ballast track structure, respectively; FIG. 4 is a schematic perspective view illustrating geosynthetics fabricated so as to be attached to a ballast cleaner;

FIG. 5 is a schematic perspective view illustrating a sleeper;

FIG. 6 is a side view illustrating a continuous injector for injecting cement mortar in order to form a new ballast layer; and

FIG. 7 is a schematic flow chart illustrating a procedure of modifying the gravel ballast track into a concrete ballast track according to the present invention.

10 Best Mode for Carrying Out the Invention

[0018] Description will now be made of the construction and effects of a concrete ballast track structure and a construction process thereof according to the present invention with reference to accompanying drawings.

[0019] FIGS. 1 to 3 are a schematic perspective view, a sectional view, and side sectional view illustrating the concrete ballast track structure according to the present invention, respectively.

[0020] As illustrated in the drawings, the concrete ballast track includes, from a lower portion thereof, a roadbed layer 10, one or more sheets of geosynthetics 30, a new ballast layer 21, a sleeper 50, a fastener 60, and a rail 70.

[0021] FIG. 4 is a schematic perspective view illustrating geosynthetics fabricated so as to be attached to a ballast cleaner. The geosynthetics 30 may be unwoven fabric, geotextile, geomembrane or others, and are installed on the roadbed layer 10 such that the bottom thereof is brought into contact with the upper surface of the roadbed layer 10, and the right and left sides thereof have the side faces perpendicular to the bottom thereof, i.e. having a cross section shaped like 'L'. Further, as illustrated in a circle showing an enlarged cross section taken along line A-A of FIG. 4, a panel having a certain width is inserted into both sides of the geosynthetics 30 such that both the sides of the geosynthetics 30 are fixedly installed perpendicular to the bottom thereof when the geosynthetics 30 are installed on the roadbed layer 10. The panel is preferably installed on both sides of the geosynthetics 30 using lattice type polypropylene by a length corresponding to height of the new ballast layer 21. Further, the geosynthetics 30 may be fabricated in roll type using a connection beam such that they are attached to the ballast cleaner so that the construction is carried out through mechanization. The installation of the geosynthetics 30 is carried out at the same time as working type 2 using the ballast cleaner or a ballast regulator, and serves to rapidly drain rainwater or inflow water around them, and prevents injected concrete from leaking, so that there is no need to install a separate invert.

[0022] The new ballast layer 21 is composed of a prepacked concrete layer consisting of new ballast gravels and high strength and super early strength cement mortar injected thereto.

[0023] The new ballast gravels constituting the new ballast layer 21 are ones that are obtained by basically recycling the existing ballast gravels. Herein, to reduce

a time taken to carry out the removal of the existing ballast gravels, the discharging of the removed gravels, and the filling of the new ballast gravels, the existing ballast gravels recycled by the ballast cleaner are washed on the spot using a dry-type washer and then are filled in the roadbed layer 10. At this time, only the gravels having a certain grain size are recycled, and the other part may be compensated with new gravels.

[0024] After the new ballast gravels are filled, as illustrated in FIG. 6, high strength and super early strength cement mortar is injected between the new ballast gravels using a continuous type injector 24 comprising a mixer 25, a mixer hood, a continuous mixer 26, a cushion tank 27, and a pump, to thereby form prepacked concrete. Since the cement mortar is injected into space between the sleepers 50 in a natural dropping manner, it should have good fluidity so as to be uniformly injected between the ballast gravels without vacancies, have a short curing time so as not to hinder the operation of the train, and have higher strength than common cement mortar having a compressive strength of 10MPa because it receives the load of the train. It is preferable that the cement mortar be of the compressive strength of 30MPa or more in order to support the load of the train. Further, it is preferable that the cement mortar be of composition to provide an uniaxial compressive strength of 0.4MPa an hour in order not to hinder the operation of the train. Further, it is preferable that admixtures such as superplasticity, and fine aggregates with constant grain size be added thereto in order to improve fluidity while considering the economical aspect. Further, it is preferable that the cement mortar be of composition by which the curing speed is fast due to having super early strength cement, high strength is obtained due to having additives with Ca^{2+} and SO_4^{2-} , and high fluidity is obtained due to having fine aggregates with constant grain size. Meanwhile, it is preferable that the grain size of the ballast gravels, that are the aggregates constituting the prepacked concrete, be of 100% passing weight ratio for 63mm mesh screen, 75 to 95% for 50mm mesh screen, 50 to 80% for 40mm mesh screen, 25 to 50% for 30mm mesh screen, 5 to 30% for 25mm mesh screen, and 0 to 10% for 20mm mesh screen.

[0025] FIG. 5 is a schematic perspective view illustrating a sleeper 50. The sleeper 50 is preferably of a wide width in order to increase load distributing capability. Further, while the sleeper 50 is preferably of heavy weight so as to reduce vibration acceleration of the gravel ballast because the gravel ballast should support the load until the cement mortar is filled, it is preferable that the sleeper 50 be of a width of 360mm in order to carry out mechanized construction using a multiple tie tamper (MTT) that is the existing maintenance device of railroad. However, the width of the sleeper 50 may vary depending upon dimension of the device used. In case of using the concrete sleeper 50, it is possible to apply post-tension to provide a lateral reinforcement for securing required tensile strength.

[0026] The fastener 60 installed on the sleeper 50 is preferably constructed such that it may be controlled in length by vertically $\pm 30\text{mm}$ or more and laterally $\pm 25\text{mm}$ or more using an insulating block or an eccentric bush so as to correct possible track deviation that may occur in the future time because the sleeper 50 and the new ballast layer 21 are integrated into one piece.

[0027] Meanwhile, an asphalt surface layer 40 may be provided on the new ballast layer 21 so as to facilitate draining of water, or prevent the surface contamination such as generation of dusts.

[0028] The construction process of the concrete ballast track having the above structure is as follows. As illustrated in FIG. 7 (a), first, existing sleepers 50 and the fasteners 60 are removed, and new sleepers 50 and fasteners 60 are installed. Herein, if machine such as a sleeper exchanger is used, 40 sleepers 50 an hour are generally exchanged. After exchanging the sleepers 50 and the fasteners 60, a rail 70 is coupled to the sleepers 50 using the exchanged fasteners 60. After the rail 70 is coupled, as illustrated in FIG. 7 (b), the existing ballast is excavated in front of the ballast cleaner using the same and the gravels are collected. Upon the existing ballast excavation, the existing ballast layer 20 is excavated in such a way as to provide an inclined shoulder layer 22 such that the upper portion of the existing ballast layer 20 rises in height as it goes outside in order to prevent the foreign matters from coming in. Herein, in the middle of the ballast cleaner, the geosynthetics 30 are installed on the roadbed layer 10 exposed by the excavation of the existing ballast layer 20, using the geosynthetics roll attached by a connection beam. In addition, in the rear of the ballast layer, the new ballast gravels that are washed on the spot using the dry-type gravel washer are filled in the internal space defined by the installation of the geosynthetics 30. The ballast cleaner can generally carry out the cleaning operation for an interval of 110m an hour, and the existing processes of the removal of the existing ballast gravels, the installing of the geosynthetics 30, the discharging of the removed gravels, and the filling of the new ballast gravels can be simultaneously carried out using such a ballast cleaner. After the cleaning by the ballast cleaner, as illustrated in FIG. 7 (c), the arrangement of track gravels and line adjustment are carried out using the MTT. Upon the line adjustment using the MTT, it can be continuously and precisely carried out using a computer, a laser guiding device and others so that the process may be conducted efficiently and precisely to the extent of generally covering an interval of 1200mm an hour. After the arrangement of the track gravels and the line adjustment, as illustrated in FIG. 7 (d), high strength and super early strength cement mortar is injected into the new gravel layer using the continuous type injector 24 to thereby form the prepacked concrete ballast layer 21.

[0029] Although the exemplary embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various

modifications, additions and substitutions are possible, without departing from the scope of the invention as disclosed in the accompanying claims.

Industrial Applicability

[0030] According to the concrete ballast track structure and the construction process thereof, the prepacked concrete is prevented from flowing out, the existing ballast gravels are re-used without removal, and the removal process of the ballast, that is dependent on labor, is carried out using the ballast cleaner so that the construction speed is greatly increased.

[0031] Further, the new ballast layer is formed with high strength and super early strength prepacked concrete, so that the present concrete ballast track does not affect the operation of the train.

[0032] Particularly, since all the construction processes are carried out using machine, the construction period is greatly shortened so that the construction process is suitable to maintenance or construction of the railway track within a restricted period, and that it can be applied to a section that may be a section where track deviation occurs repeatedly, and sections such as a connecting part, a welded part or the like where track deviation possibly occurs.

Claims

1. A prepacked concrete track construction process comprising the steps of exchanging existing sleeper (50) and existing fastener (60), coupling a rail (70) to the exchanged sleeper (50) using an exchanged fastener (60), excavating an existing ballast layer (20) using a ballast cleaner, and installing geosynthetics (30) on a roadbed layer (10), wherein the geosynthetics are installed on the roadbed layer (10) such that the bottom thereof is brought into contact with the upper surface of the roadbed layer (10), and the right and left sides thereof have the side faces perpendicular to the bottom thereof, wherein the prepacked concrete track construction process comprises dry-washing the existing ballast gravels, and filling the new ballast gravels obtained by basically recycling the existing ballast gravels in the internal space where the geosynthetics (30) are installed; position-adjusting the rail (70) using a multiple tie tamper (MTT); and injecting high strength and super early strength cement mortar into the new ballast gravel layer to form a prepacked concrete layer (21), wherein the prepacked concrete comprises ballast gravels and high strength and super early strength cement mortar injected thereto.
2. The prepacked concrete track construction process according to claim 1, wherein in the step of excavat-

ing the existing ballast layer (20) using the ballast cleaner, installing geosynthetics (30) on the roadbed layer (10), dry-washing the existing ballast gravels, and filling the new ballast gravels in the internal space where the geosynthetics (30) are installed, with once operation of the ballast cleaner, the excavation of the existing ballast layer (20) is carried out in front of the ballast cleaner, and at the same time, the installation of the geosynthetics (30) is carried out in the middle of the ballast cleaner, and the filling of the new ballast gravels is carried out in the rear of the ballast cleaner.

15 Patentansprüche

1. Verfahren zur Herstellung von Gleisen aus Pressbeton mit den folgenden Schritten:

Austauschen der existierenden Schwelle (50) und der existierenden Befestigungseinrichtung (60), Verbinden einer Schiene (70) mit der Austauschschwelle (50) unter Verwendung einer Austauschbefestigungseinrichtung (60), Ausheben einer existierenden Schottererschicht (20) unter Verwendung einer Bettungsreinigungsvorrichtung, und Installieren von Geokunststoffen (30) auf einer Bahnkörperschicht (10), wobei der Geokunststoff derart auf der Bahnkörperschicht (10) installiert wird, dass die Unterseite desselben in Kontakt mit der Oberseite der Bahnkörperschicht (10) gebracht ist, und dass die Seitenflächen der rechten und der linken Seite desselben senkrecht zur Unterseite desselben verlaufen, wobei das Verfahren zur Herstellung von Gleisen aus Pressbeton das trockene Waschen des existierenden Ballastschotters und das Füllen des durch im Wesentlichen recycelten Ballastschotter erhaltenen neuen Ballastschotters in den Innenraum, in dem der Geokunststoff (30) installiert ist; Anpassen der Position der Schiene (70) unter Verwendung eines Multi-Schwellen-Stopfgeräts (MTT); und Spritzen von hochfestem und extrem schnell festem Zementmörtel in die neue Ballastschottererschicht zur Bildung einer Pressbetonschicht (21); wobei der Pressbeton Ballastschotter und in diesen gespritzten hochfesten und extrem schnell festen Zementmörtel aufweist.

2. Verfahren zur Herstellung von Gleisen aus Pressbeton nach Anspruch 1, bei welchem bei den Schritten des Aushebens einer existierenden Schottererschicht (20) unter Verwendung einer Bettungsreinigungsvorrichtung, des Installierens des Geokunst-

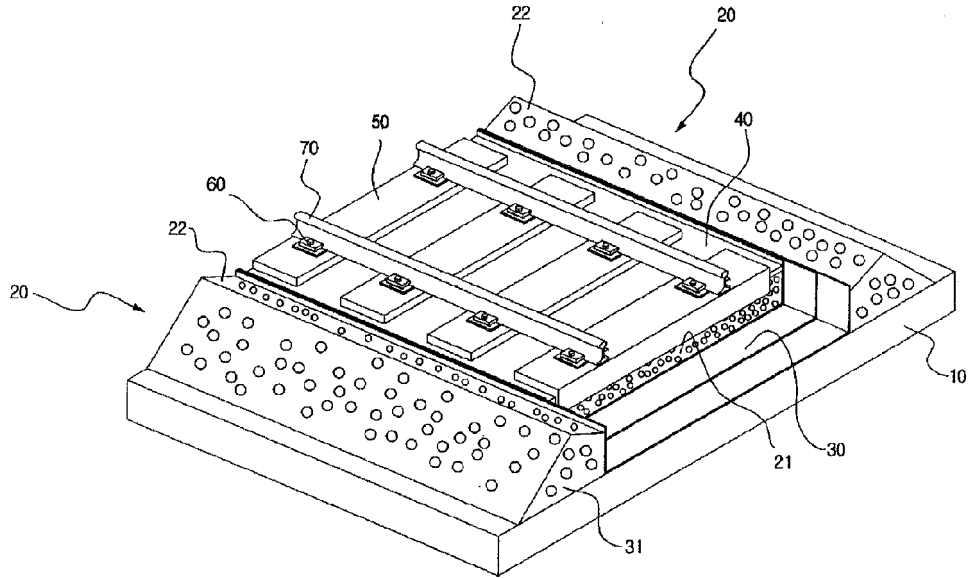
stoffs auf der Bahnkörperschicht (10), des trockenen Waschens des existierenden Ballastschotters und des Füllens des neuen Ballastschotters in den Innenraum, in dem der Geokunststoff (30) installiert ist, in einem einzigen Arbeitsgang der Bettungsreinigungsvorrichtung das Ausheben der existierenden Ballastschicht (20) vor der Bettungsreinigungsvorrichtung erfolgt, und zur gleichen Zeit das Installieren des Geokunststoffs (30) in der Mitte der Bettungsreinigungsvorrichtung und das Einfüllen des neuen Ballastschotters hinter der Bettungsreinigungsvorrichtung durchgeführt wird.

sage de la dégarnisseuse-cribleuse, l'excavation de la couche de ballast (20) existante est effectuée devant la dégarnisseuse-cribleuse et en même temps, l'installation des géosynthétiques (30) est effectuée au milieu de la dégarnisseuse-cribleuse et le remplissage avec les nouveaux graviers de ballast est effectué à l'arrière de la dégarnisseuse-cribleuse.

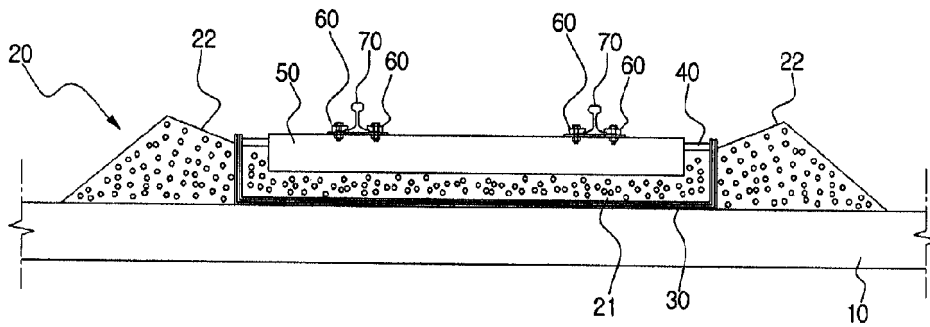
Revendications

1. Procédé de construction de voie en béton préconditionné comprenant les étapes consistant à échanger une traverse (50) existante et une pièce de fixation (60) existante, accoupler un rail (70) à la traverse (50) échangée à l'aide d'une pièce de fixation (60) échangée, excaver une couche de ballast (20) existante à l'aide d'une dégarnisseuse-cribleuse et installer des géosynthétiques (30) sur une couche de plateforme (10), dans lequel les géosynthétiques sont installés sur la couche de plateforme (10) de façon telle que leur partie inférieure est mise en contact avec la surface supérieure de la couche de plateforme (10) et leurs côtés droit et gauche ont les faces latérales perpendiculaires à leur partie inférieure, le procédé de construction de voie en béton préconditionné comprenant le lavage à sec des graviers de ballast existants et le remplissage de l'espace interne où les géosynthétiques (30) sont installés avec des nouveaux graviers de ballast obtenus essentiellement par recyclage des graviers de ballast existants ; l'ajustement de position du rail (70) à l'aide d'une bourreuse à pioches multiples (MTT) ; et l'injection de mortier de ciment à haute résistance et à très haute résistance initiale dans la nouvelle couche de graviers de ballast pour former une couche de béton préconditionné (21), dans lequel le béton préconditionné comprend des graviers de ballast et du mortier de ciment à haute résistance et à très haute résistance initiale injecté dans ceux-ci.
2. Procédé de construction de voie en béton préconditionné selon la revendication 1, dans lequel dans l'étape d'excavation de la couche de ballast (20) existante à l'aide de la dégarnisseuse-cribleuse, d'installation de géosynthétiques (30) sur la couche de plateforme (10), de lavage à sec des graviers de ballast existants et de remplissage de l'espace interne où les géosynthétiques (30) sont installés avec les nouveaux graviers de ballast, avec un seul pas-

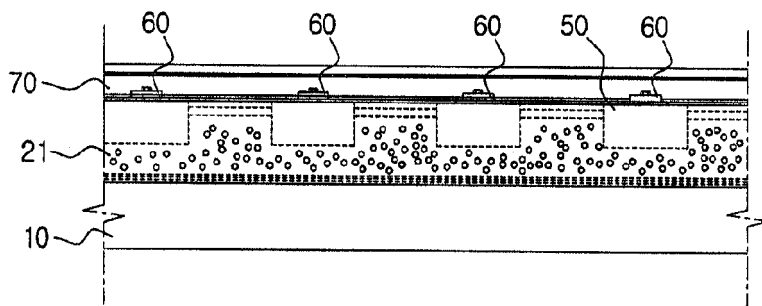
[Fig. 1]



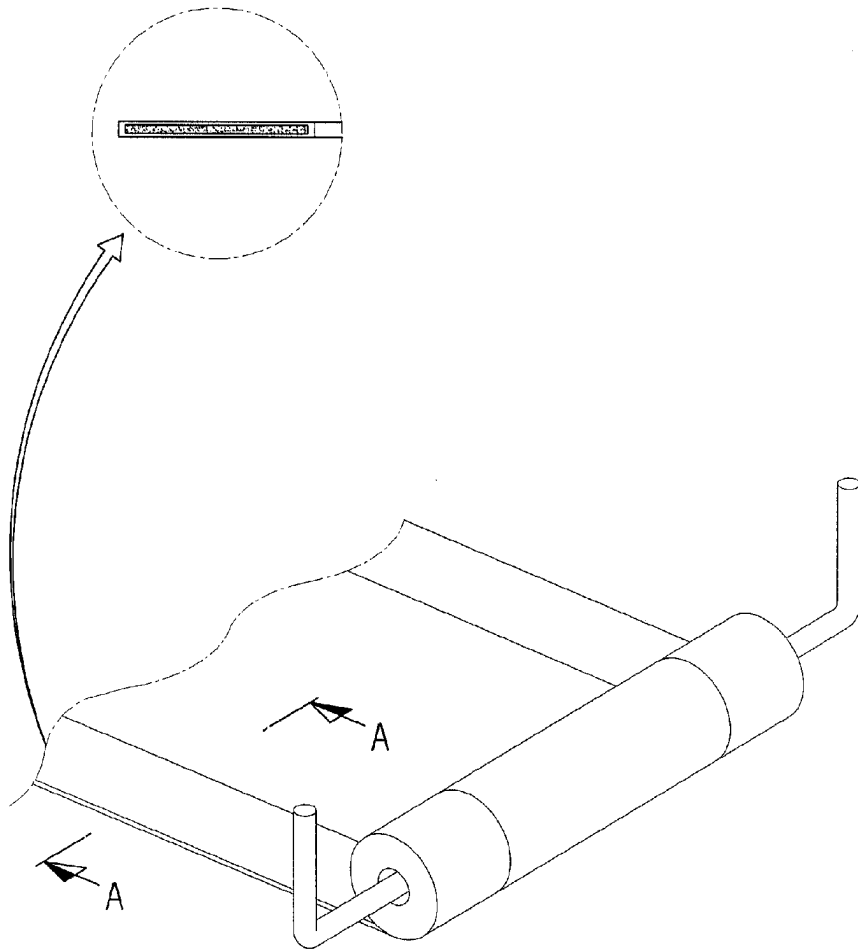
[Fig. 2]



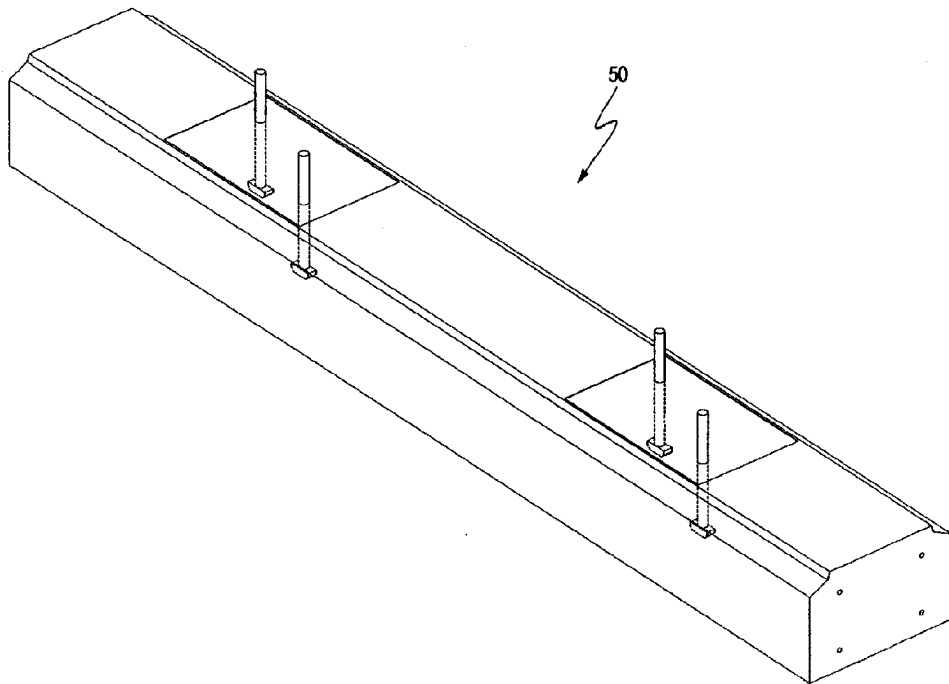
[Fig. 3]



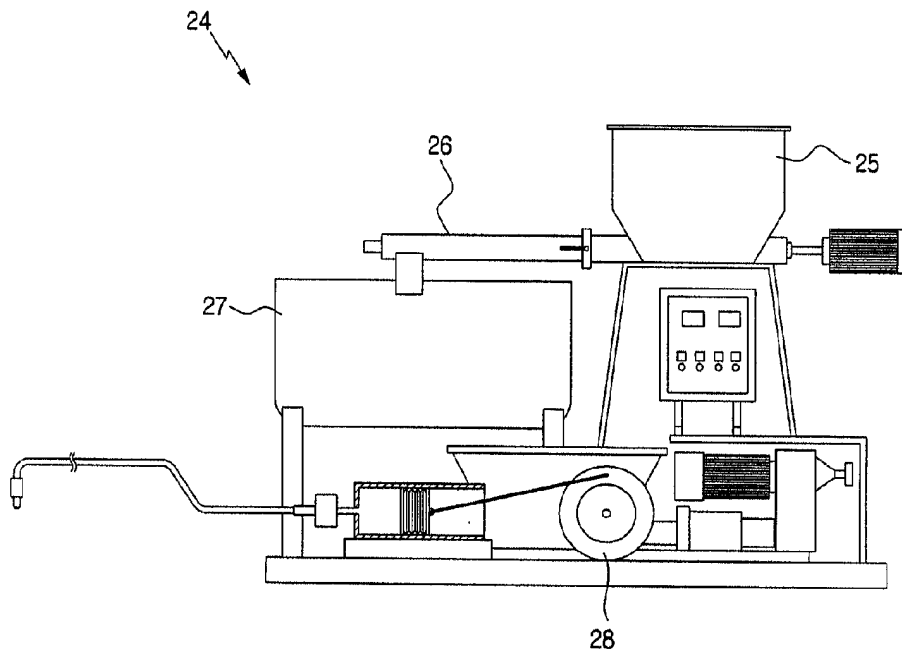
[Fig. 4]



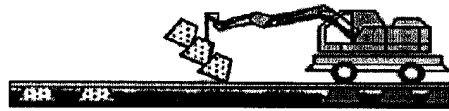
[Fig. 5]



[Fig. 6]



[Fig. 7]



(a)



(b)



(c)



(d)

REFERENCES CITED IN THE DESCRIPTION

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